Volume I, Appendix C
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C   Appendix – Usability

C.1   Scope

This appendix addresses the design of the voting system to meet the needs of the voters, that is, to develop the interfaces between the voter and the system that are easy to use and that minimize voter errors due to poor interface design. Depending on the voting technology employed, the main elements of this interface are:

♦   Information displays, e.g., presentations of contests, candidates, propositions, and instructions

♦   Vote input fields, e.g., the location where the voter indicates his or her selection; and

♦   Navigation aids, e.g., the way that voters "move" from one part of the system to another.

The most effective interfaces are almost transparent to the voter. They enable the voter to devote his or her complete attention to the task at hand - voting for the candidates and propositions of their choice. A good voter-voting system interface guides the voter to appropriate behavior. It should be obvious to the voter what he or she should do, and importantly, what seems obvious to the voter should be correct. To the extent that the design confuses the voter or causes the voter to stop and think, for example "where on this ballot do I place my vote" or "how do I change my vote," attention is directed away from the voter's main task and to the interface. At best, this can lead to voter frustration. The voter must shift attention away from voting to figuring out how to use the voting system. At worst, it can lead to errors such as failing to vote for a contest, improperly indicating the vote so it is not counted, or voting for more than the required number of candidates.

Designing effective and usable interfaces between the voter and the voting system involves a number of activities. First, voter task requirements should be identified. The requirements reflect the fact that the way that voters interact with the system is different depending on the voting system technology. For example, the way a voter casts a vote and navigates through a ballot will be quite different for a paper ballot

when compared to a computer-based voting system. These tasks need to be carefully analyzed and addressed in the design.

Second, human factors design guidelines should be used to guide the interface design. These guidelines have evolved from scientific research on the human performance aspects of system design and from many years of application in the design of systems. Their application can help to ensure that the design of voting systems is consistent with and compatible with the physical and cognitive characteristics of the voting public.

Third, usability tests and evaluations should be conducted to ensure the voting system has achieved its design goals. In part, these tests can help verify that the design features recommended in this Appendix are successfully implemented in the final voting system design. Usability tests are based on the feedback and performance of samples of voters and can help identify aspect of the design that may be unclear to voters. Results from the tests and evaluations can be used to correct any design deficiencies before the system are actually used for voting.

While all three activities are important, this appendix mainly addresses the second activity discussed above. It provides guidance on the design of usable voter-voting system interfaces based on human factors principles.

C.2   General Principles

The equipment used by voters to cast ballots should meet the following general principles:

- ♦ The design should support voter tasks by providing alerts, information, instructions, and controls when and where they are needed;

- ♦ The design should ensure compatibility with human physiological and cognitive characteristics and limitations, including: visual and auditory perception, information processing and memory, anthropometry and biomechanics;

- ♦ The design should ensure voter safety. The potential for hazards such as sharp edges, falling objects, pinch points, and electrical shock should be anticipated and eliminated as much as possible from the design;

- ♦ Design conventions should be established to provide consistency and standardization of the voter's interface with the system;

- ♦ The system should be the simplest design needed to meet its intended function;

♦ The design should provide guidance to the voter through the balloting process;

♦ The design should minimize voter inputs, e.g., don't add unnecessary steps, minimize need to turn pages, and to navigate displays;

♦ The design should minimize attention shifts and interruptions, e.g., all necessary information to cast a vote for a single race should in one place without the need to turn pages or page to other screens; and

♦ Provisions should be made to accommodate the unique demands of all voters. Additional criteria for accessibility that are mandated by the Standards is discussed in 2.2.7.

C.3   Overall Design and Layout of the Voter Workspace

The workspace is the booth, workstation, or other location provided by the election district where the voter goes to use the paper, mechanical, or electronic systems provided for voting.

The ballot and supporting system elements should be properly located so the displays are directly within the voter's visual field and comfortably with the voter's reach. This may require making the voter-system interface adjustable so voters can adjust the interface for their unique demands. Alternatively, different workspaces can be provided where equipment is positioned to accommodate voters of different heights, voters who are in wheel chairs, and voters that have to sit.

All displays and controls should be located to avoid parallax. Parallax refers to the apparent change in the relative positions of objects depending on the position of the viewer. Error will be minimized if the distance between the displays and controls is small, and if the ballot is located so that it can be viewed "straight-on," i.e., with the observer's line of sight perpendicular to the plane of the ballot.

The ambient lighting provided should be consistent with the balloting technology used. More lighting should be provided for paper ballots than for electronic ballots. When VDU are used, ensure that lighting does not produce glare or reflections on screens. Where both VDU and paper must be used, task lighting for reading paper should be provided.

When ballots extend to more than one page (paper or electronic) the same general organization layout should be used for all pages, i.e. location of page identifiers, page numbers, items to be voted on, navigation aids, etc.

C.4   Ballot Legibility and Understandability

In order to facilitate usability, voting system designers should play close attention to design elements that affect the voter's ability to clearly read and easily understand the information provided. The following guidance addresses these design features:

a. The font size and style used should ensure that written material can be easily and unambiguously read. Special provisions may be needed for visually-impaired voters:

   1) Text (except labels) should be presented using upper and lower case characters. Reading text is easier and faster when capitalization is used conventionally to start sentences and to indicate proper nouns and acronyms;

   2) A clearly legible font should be utilized. Fonts should have true ascenders and descenders, uniform stroke width, and uniform aspect ratio. Preference should be given to simple styles. Script and other highly stylized fonts should be avoided;

   3) For a given font, it should be possible to clearly distinguish between the following characters: X and K, T and Y, I and L, I and 1, O and Q, O and 0, S and 5, and U and V;

   4) Character size should be large enough to easily read the text from the normal sitting and standing position without squinting or leaning forward for a person with normal corrected vision (guidance for character size is provided in Table C-1;

   > **Table C-1 Approximate Point Sizes For Different Viewing Distances**
   >
   > | Viewing Distance | Minimum | Preferred |
   > | --- | --- | --- |
   > | 25 | 9 | 12 |
   > | 30 | 10 | 14 |
   > | 36 | 12 | 17 |
   > | 42 | 14 | 20 |
   > | 48 | 16 | 22 |
   >
   > Note: Point sizes refer to the size of letters when printed. When viewed on monitors, it is not exactly the same.

b. Instructions should be concise. Instructions should be designed to communicate information clearly and unambiguously so that they can be easily understood and interpreted without error:

1) Instructions should be available in the voter's preferred language (as required by the Voting Rights Act of 1965);

2) Instructions should be written as short sentences with short, simple words;

3) Instruction steps should be written in active voice as positive commands (focusing on what to do, not what not to do);

4) Punctuation should conform to standard usage of the language used;

5) Words, phrases, and names used in instructions should be used consistently within and among instructions and all other the voting system components;

6) Abbreviations and acronyms should be avoided or, if necessary, limited to those well known to the voters;

7) If instructions include number lists, Arabic numerals should be used. Numbers that are spelled out should be consistently spelled under the same conditions;

8) The instructions should specify any conditions that must be met before an action can be undertaken. Information about preconditions should be located so that voters read the information before acting. Information given in other locations may be overlooked, or require additional actions to retrieve it, which may be distracting and time consuming. Further, if conditions are implied, voters may easily miss or misinterpret them;

9) Applicable cautions or warnings should be displayed when the relevant instructions are in view of the voter. Displaying warnings and cautions at the same time as their associated instructions will help ensure that voters read the information. Information provided elsewhere may be overlooked, or may require retrieval by distracting and time-consuming actions;

10) Cautions or warnings should be uniquely presented, so that they are easily distinguished from each other and from other display elements; and

11) All supplementary information (such as explanatory figures) required for a procedure step should be shown concurrently with the step;

c. Graphics should be simple and have an obvious meaning that is consistent with population stereotypes (unless well known graphics are used, the meaning of graphics should be tested in advance to ensure the they communicate the intended message). Voter understanding of graphics can be enhanced when the graphics are accompanied by instructional labels. For example, if an arrow is used to indicate where to vote it may be more clearly understood if the text "To register your vote, click here";

d. If the information is communicated by means of visual coding, such as by color or shape, the following principles should be followed:

   1) A limited number of codes should be used;

   2) The meaning of code levels should be clearly presented to the voter;

   3) Voters should be able to easily discriminate between the levels of the code, e.g., the different colors; and

   4) If the information being coded differs in importance, the code levels should be mapped for salience, e.g., most salient display characteristics should direct voter's attention to the most important information;

e. Decorative features with no information content should be minimized since they can create distractions; and

f. All information (e.g., contest labels, candidate names, instructions, graphics, and coding) should have good contrast against the background.

C.5   Information Grouping

Proper use of information is facilitated by the application of grouping principles. When information is presented in a display, people have a tendency to group elements in the display based on how they are presented. It is far preferable to intentionally design the voting system display for proper grouping than to leave it to chance. The guidance in this section addresses these design considerations.

a. Information on the ballot should be grouped. A group should include the following:

   1) Candidates for a given office;

   2) The office for which a group of candidates are running; and

   3) Vote response fields;

b. Any applicable instructions pertinent to the specific vote, such as an indication of the number of candidates to vote for;

c. Information on the ballot should reflect principles of grouping:

1) A group should be visually distinct, e.g., examples of techniques that can be used to visually set apart a group include boarders and demarcations, background color, and textures;

2) The office for which a group of candidates are running should be prominently labeled; and

3) The names should be grouped so they appear together (not on separate areas of the display or separate pages); and

4) There should be clear separations between groups. The separations between the groups should be greater than the separation between the items of information within a group.

C.6   Voting Input Fields

The design of the voting input field is as important as the presentation of information itself. The design should make it clear where and how to vote and the system should provide feedback that the vote was accepted by the system.   The guidance in this section addresses these design features.

a.   Ballot should clearly indicate the action voters must take to cast a vote and where the action must be made in order to vote for specific candidates;

b.   There should be a consistent relationship between names of the candidates and where to cast a vote. For example, if the response field where voters indicate their selection is located to the right of a candidates name, it should always be located to the right of all candidates names and never to the left or some alternative position. The reason for this is that people are active information processors and will abstract rules about the relationships between information elements in the display. The rules then guide their subsequent behavior. If the design in inconsistent, applying the rule leads to error. Consistency, therefore, will help establish voter expectancy with balloting systems and minimize errors;

c.   Ballot should clearly indicate how many candidates are to be voted for;

d.   The design should support the ability of the voter to remain in visual contact with the current options when in the act of casting their vote. That is, the design should minimize as much as possible, the occlusion of the current item being voted for by the voting action, such as when the movement of the voter's hand to cast a vote blocks information on the display;

e.   Feedback on the voter's selection should be provided. It should be clearly obvious to voters what they voted for. In paper ballots, this is supported by

clear grouping principles. In electronic systems, an informative feedback message should be provided;

f. Voters should be able to review all their votes prior to final submission. While this is easily to implement in electronic systems it can be more difficult with some paper ballots, like punch cards. In such cases, where possible, it is desirable to provide voters with easy access to a punch card reader or similar device to check that their votes were cast as intended;

g. Voters should be able to modify their votes at any time before finalizing their voting session;

h. In electronic and computer-based systems, fields where voters have to enter identifying information, if any, should be clearly labeled and the place where the information is to go should be clearly visible;

i. In computer-based systems, the cursor should be automatically positioned in the first data entry field and when the voter hits the "enter/return" key, the cursor should automatically move to the next data entry field;

j. Voters should be able to correct the information if mistakes are made; and

k. In electronic and computer-based systems, voters should not have to input identifying information more that once, e.g., if voters input their names at the beginning of the voting session, they should not have to repeat the input on subsequent pages.

C.7   Navigation and Manipulation of Ballots

As noted earlier, navigation and manipulation of ballots can be a distracting task that shifts the voter's attention away from the voting task and, therefore, can increase the probability of error. Therefore, careful attention has to be paid to the design of these aspects of the voting system. The guidance provided in this section is intended to minimize the demands of these activities.

a. Voters should be able to control the pace and sequence of their use of the ballot. Voters should be able to freely move back and forth;

b. The means by which voters navigate through the system should be simple and not require complex or complicated actions (e.g., clicking on a "Next Page" button rather than scrolling);

c. The display should provide orientation and landmark features to support the voter in determining where they are in the ballot;

d. Navigation features should be provided that are distinct and should be clearly separated from voting response fields;

e. Any cursors should be visually distinct and should not move beyond the boundaries of the screen (become invisible);

f. The input device (such as a mouse) and cursor response to voter movements should be as precise as needed to reliably enter a vote; and

g. The system should provide feedback to user inputs in less than a second, but if processing takes longer, feedback should be provided that the system is processing the voter's input.

C.8 Preventing and Minimizing Voter Errors

During the design of voting systems, it is important to anticipate the types of errors voters may make so that features can be deigned to minimize voter errors and to provide the means for voters to realize their errors and correct them. The guidance in this section addresses these design considerations.

a. The system should provide clear and explicit instructions on what procedures the user should follow throughout the voting process.

b. The system should check user inputs for acceptability, e.g., check for inputs that seem to be in error (such as putting a Arabic number in a name field) and alert the voter when such a situation exists;

c. When feasible, interlocks should prevent voters from voting for more candidates than is permitted or from providing other types of unacceptable voter inputs. When this occurs, voters should be alerted as to what is incorrect;

d. The system should inform voters of items on the ballot that they have not voted for. This should be done before the voter leaves the system. Voters should be given the opportunity to compete their vote if they choose to or they should be able to exit without voting for those they omitted; and

e. A means for correcting a vote response should be readily available. For non-paper based systems, this should be built into the design of the system. For paper-based system, procedures for undoing votes should be available and voters should be explicitly told in advance what they are and that information should be posted close to where they will use the ballot.

C.9   Help and System Failure

The availability of useful help features can support voting system usability. Similarly, the voter should be alerted to any system failures that may impact the proper recording of votes or personal safety. The guidance in this section addresses these design considerations.

    a.   Help should be available to support users with specific questions;

    b.   The system should provide voters with information on what to do if the instructions provided are not understood;

    c.   Acceptable voter behavior should be clearly identified (e.g., whether the voter can leave the booth, open a curtain, remove a ballot, etc.);

    d.   System messages should be informative and in "plain English" and should not contain technical or jargon terms;

    e.   Alarms should be provided to alert voters to system failures. The alarms should be accompanied by instructions informing voters of the actions to take; and

    f.   Status and alarm displays should follow conventional practice with respect to color:

        1) Green, blue, or white displays shall be used for indications of normal status;

        2) Amber indicators shall be used to indicate warnings or marginal status;

        3) Red indicators shall be used to indicate error conditions or equipment states that may result in damage, or in hazards to personnel; and

        4) unless the equipment is designed to halt under conditions of incipient damage or hazard, an audible alarm shall also be provided.

C.10   Voter Familiarization and Training

Successful use of any voting system is supported by the availability of mean for voters to become familiar with voting system operation. Being able to use and become familiar with the system prior to voting will minimize confusion and errors. The guidance in this section addresses these design considerations.

a. Voters should have access to sample ballots and all instructions before they have to vote;

b. Voters should have an opportunity to practice before they vote, especially if using electronic systems. On-line support can be provided, e.g., provide web-based access to all ballot information; and

c. Voters should have access to knowledgeable personnel to resolve any questions.